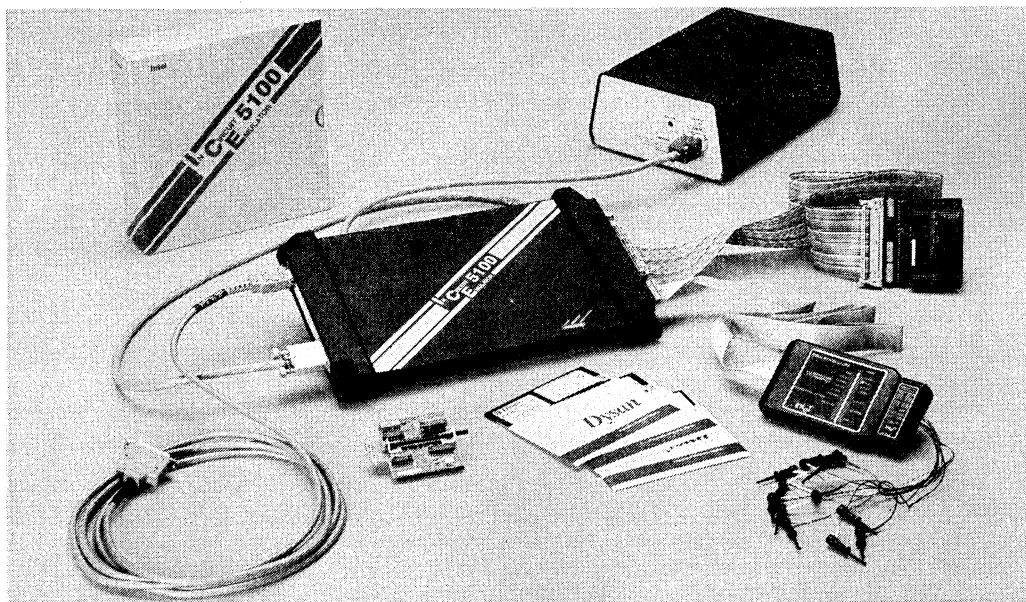




## ICE™-5100/452 IN-CIRCUIT EMULATOR FOR THE UPI™-452 FAMILY OF PROGRAMMABLE I/O PROCESSORS

- Precise, full-speed, real-time emulation of the UPI™-452 family of I/O processors
- 64 KB of mappable high-speed emulation memory
- 254 24-bit frames of trace memory (16 bits trace program execution addresses and 8 bits trace external events)
- Serial link to the IBM\* PC AT, PC XT (and DOS compatibles), and the Intellec® Series III/IV
- ASM-51 and PL/M-51 language support
- Full emulation and debug support for the FIFO buffer
- Built-in CRT-oriented text editor
- Symbolic debugging enables access to memory locations and program variables
- Four address breakpoints with in-range, out-of-range, and page breaks
- Equipped with the Integrated Command Directory (ICD™) that provides:
  - On-line help
  - Syntax guidance and checking
  - Dynamic command entry
  - Error checking
  - Command recall
- On-line disassembler and single-line assembler to help with code patching

The ICE™-5100/452 in-circuit emulator is a high-level, interactive debugger that is used to develop and test the hardware and software of a target system based on the UPI™-452 family of I/O processors. The ICE-5100/452 emulator can be serially linked to an Intellec® Series III/IV or an IBM PC AT or PC XT. The emulator can communicate with the host system at standard baud rates up to 19.2K.



\*IBM is a registered trademark of International Business Machines Corporation.

## PRODUCT OVERVIEW

The ICE-5100/452 emulator provides full emulation support for the UPI-452 family of I/O processors. The UPI-452 family consists of the 83452, 87452, and the 80452.

The ICE-5100/452 emulator enables hardware and software development to proceed simultaneously. With the ICE-5100/452 emulator, prototype hardware can be added to the system as it is designed and software can be developed prior to the completion of the hardware prototype. Software and hardware integration can occur while the product is being developed.

The ICE-5100/452 emulator assists four stages of development:

- Software debugging
- Hardware debugging
- System integration
- System test

## SOFTWARE DEBUGGING

The ICE-5100/452 emulator can be operated without being connected to the target system and before any of the user's hardware is available (provided external data RAM is not needed). In this stand-alone mode, the ICE-5100/452 emulator can be used to facilitate program development.

## HARDWARE DEBUGGING

The ICE-5100/452 emulator's AC/DC parametric characteristics match the microcontroller's. The emulator's full-speed operation makes it a valuable tool for debugging hardware, including time-critical serial port, timer, and external interrupt interfaces.

## SYSTEM INTEGRATION

Integration of software and hardware can begin when the emulator is plugged into the microcontroller socket of the prototype system hardware. Hardware can be added, modified, and tested immediately. As each section of the user's hardware is completed, it can be added to the prototype. Thus, the hardware and software can be system tested in real-time operation as each section becomes available.

## SYSTEM TEST

When the prototype is complete, it is tested with the final version of the system software. The ICE-5100/452 emulator is then used for real-time emulation

of the microcontroller to debug the system as a completed unit.

The final product verification test can be performed using the ROM or EPROM version of the microcontroller. Thus, the ICE-5100/452 emulator provides the ability to debug a prototype or production system at any stage in its development without introducing extraneous hardware or software test tools.

## PHYSICAL DESCRIPTION

The ICE-5100/452 emulator consists of the following components (see Figure 1):

- Power supply
- AC and DC power cables
- Controller pod
- Serial cable (host-specific)
- User probe assembly (consisting of the processor module and the user cable)
- Crystal power accessory (CPA)
- 68-pin PGA target adaptor
- Clips assembly
- Software (includes the ICE-5100/452 emulator software, diagnostic software, and a tutorial)

The controller pod contains 64 KB of emulation memory, 254- by 24-bit frames of trace memory, and the control processor. In addition, the controller pod houses a BNC connector that can be used to connect up to 10 multi-ICE compatible emulators for synchronous starting and stopping of emulation.

The serial cable connects the host system to the controller pod. The serial cable supports a subset of the RS-232C signals.

The user probe assembly consists of a user cable and a processor module. The processor module houses the emulation processor and the interface logic. The target adaptor connects to the processor module and provides an electrical and mechanical interface to the target microcontroller socket.

The crystal power accessory (CPA) is a small, detachable board that connects to the controller pod and enables the ICE-5100/452 emulator to run in stand-alone mode. The target adaptor plugs into the socket on the CPA; the CPA then supplies clock and power to the user probe.

The clips assembly enables the user to trace external events. Eight bits of data are gathered on the rising edge of PSEN during opcode fetches. The clips information can be displayed using the CLIPS option with the PRINT command. Trace qualification input

and output lines are also provided on the clips pod for connection to test equipment.

The ICE-5100/452 emulator software supports mnemonics, object file formats, and symbolic references generated by Intel's ASM-51 and PL/M-51 programming languages. Along with the ICE-5100/452 emulator software is a customer confidence test disk with diagnostic routines that check the operation of the hardware.

The on-line tutorial is written in the ICE-5100 command language. Thus, the user is able to interact with and use the ICE-5100/452 emulator while executing the tutorial.

A comprehensive set of documentation is provided with the ICE-5100/452 emulator.

## ICE™-5100/452 EMULATOR FEATURES

The ICE-5100/452 emulator has been created to assist a product designer in developing, debugging and testing designs incorporating the UPI-452 family of I/O processors. The following sections detail some of the ICE-5100/452 emulator features.

## EMULATION

Emulation is the controlled execution of the user's software in the target hardware or in an artificial hardware environment that duplicates the microcontroller of the target system. Emulation is a transparent process that happens in real-time. The execution of the user software is facilitated with the ICE-5100/452 command language.

## MEMORY MAPPING

The memory space for the 452 microcontroller and its target hardware is fully accessible through the emulator. The ICE-5100/452 emulator refers to four physically distinct memory spaces, as follows:

- CODE — references program memory
- IDATA — references internal data memory
- RDATA — references special function register memory
- XDATA — references external data memory

ICE-5100/452 emulator commands that access memory use one of the special prefixes (e.g., CODE) to specify the memory space.

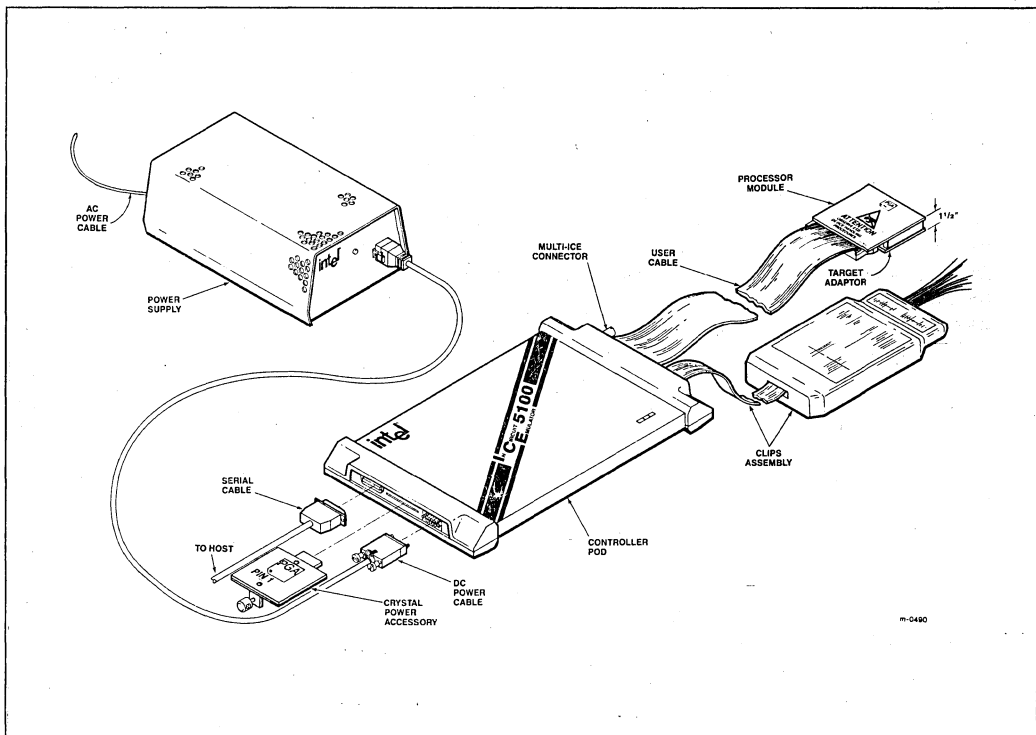


Figure 1. The ICE™-5100/452 Emulator Hardware

The ICE-5100/452 emulator has the following FIFO buffer access commands:

- **FCLR** Resets the entire FIFO buffer, or resets either the input portion or the output portion.
- **FDUMP** Performs a non-destructive read of the input or output FIFO buffer.
- **FWRITE** Loads values into the input or output FIFO buffer.
- **FREAD** Simulates a component read or a host system read of the FIFO buffer.
- **FREEZE** Enables or disables the FIFO buffer access to the host CPU.

The microcontroller's special function registers and register bits can be accessed mnemonically (e.g., DPL, TCON, CY) with the ICE-5100/452 emulator software.

Data can be displayed or modified in one of three bases: hexadecimal, decimal, and binary. Data can also be displayed or modified in one of two formats: ASCII and unsigned integer. Program code can be disassembled and displayed as ASM-51 assembler mnemonics. Code can be modified with standard ASM-51 statements using the built-in single-line assembler.

Symbolic references can be used to specify memory locations. A symbolic reference is a procedure name, line number, program variable, or label in the user program that corresponds to a location.

Some typical symbolic functions include:

- Changing or inspecting the value of a program variable by using its symbolic name to access the memory location.
- Defining break and trace events using symbolic references.
- Referencing variables as primitive data types. The primitive data types are ADDRESS, BIT, BOOLEAN, BYTE, CHAR (character), and WORD.

The ICE-5100/452 emulator maintains a virtual symbol table (VST) for program symbols. A maximum of 61 KB of host memory space is available for the VST. If the VST is larger than 61 KB, the excess is stored on available host system disk space and is paged in and out as needed. The size of the VST is limited only by the disk capacity of the host system.

## **BREAKPOINT SPECIFICATIONS**

Breakpoints are used to halt a user program in order to examine the effect of the program's execution on the target system. The ICE-5100/452 emulator supports three different types of break specifications:

- **Specific address break** — a single address point can be specified to halt emulation.
- **Range break** — an arbitrary range of addresses can be specified to halt emulation. Program execution within or, optionally, outside the range halts emulation.
- **Page break** — up to 256 page breaks can be specified to halt emulation. A page break is defined as a range of addresses that is 256-bytes long and begins on a 256-byte address boundary.

Break registers are user-defined debug definitions used to create and store breakpoint definitions. Break registers can contain multiple breakpoint definitions and can optionally call debug procedures when emulation halts.

## **TRACE SPECIFICATIONS**

Tracing can be triggered using specifications similar to those used for breaking. Normally, the ICE-5100/452 emulator traces program activity while the user program is executing. With a trace specification, tracing can be triggered to occur only when specific conditions are met during execution. Up to 254 24-bit frames of trace information are collected in a buffer during emulation. Sixteen of the 24 bits trace instruction execution addresses, and 8 bits capture external events (CLIPS).

The trace buffer display is similar to an ASM-51 program listing as shown in Figure 2. The PRINT command enables the user to selectively display the contents of the trace buffer. The user has the option of displaying the clips information as well as disassembled instructions.

## PROCEDURES

Debugging procedures (PROCs) are a user-named group of ICE-5100/452 commands that are executed as one command. PROCs enable the user to define several commands in a named block structure. The commands are executed by entering the name of the PROC. The PROC bodies are a simple DO...END construct.

PROCs can simulate missing hardware or software, collect debug information, and execute high-level software patches. PROCs can be copied to text files on disk, then recalled for use in later test sessions. PROCs can also serve as program diagnostics, implementing ICE-5100/452 emulator commands or user-defined definitions for special purposes. PROCs can also be used to set breakpoints.

## ON-LINE SYNTAX MENU

A special syntax menu, called the Integrated Command Directory (ICD), similar to the one used for the I<sup>2</sup>C<sup>™</sup> system and the VLSiCE-96 emulator, aids in creating syntactically correct command lines. Figure 3 shows an example of the ICD and how it changes to reflect the options available for the GO command.

## HELP

The HELP command provides ICE-5100/452 emulation command assistance via the host system terminal. On-line HELP is available for the ICE-5100/452 emulator commands shown in Figure 4.

## DESIGN CONSIDERATIONS

The height of the processor module and the target adaptor need to be considered for target systems. Allow at least 1½ inches (3.8 cm) of space to fit the processor module and target adaptor. Figure 5 shows the dimensions of the processor module.

```

hlt>PRINT NEWEST 4      /* Print newest four instructions in
                        buffer */
FRAME      ADDRESS  CODE  INSTRUCTION
(028)      300A     C02A  PUSH  2AH
(030)      300C     2532  ADD   A,32H
(032)      300E     F52A  MOV   2AH,A
(034)      3010     B53210 CJNE  A,32H,#+10H
hlt>
hlt>PRINT CLIPS OLDEST 2 /* Buffer display showing clips */
FRAME      ADDRESS  CODE  INSTRUCTION      CLIPS (7b543210)
(000)      300A     C02A  PUSH  2AH           01110011
(001)      300C     2532  ADD   A,32H          11110101
hlt>

```

Figure 2. Selected Trace Buffer Displays

<pre>hlt&gt; GO FROM ARM FOREVER TIL USING TRACE ; &lt;execute&gt;</pre>
<pre>hlt&gt; GO FROM &lt;expr&gt;</pre>
<pre>hlt&gt; GO FROM 13H &lt;operator&gt; ARM FOREVER TIL USING TRACE ; &lt;execute&gt;</pre>
<pre>hlt&gt; GO FROM 13H USING BRKREG &lt;brkreg name&gt;</pre>
<pre>hlt&gt; GO FROM 13H USING br1 TRACE ; &lt;execute&gt;</pre>
<pre>hlt&gt; GO FROM 13H USING br1 TRACE &lt;expr&gt; OUTSIDE PAGE FROM TIL &lt;trcreg name&gt; ; &lt;execute&gt;</pre>
<pre>hlt&gt; GO FROM 13H USING br1 TRACE traceit ; &lt;execute&gt;</pre>

Figure 3. The Integrated Command Directory for the GO Command

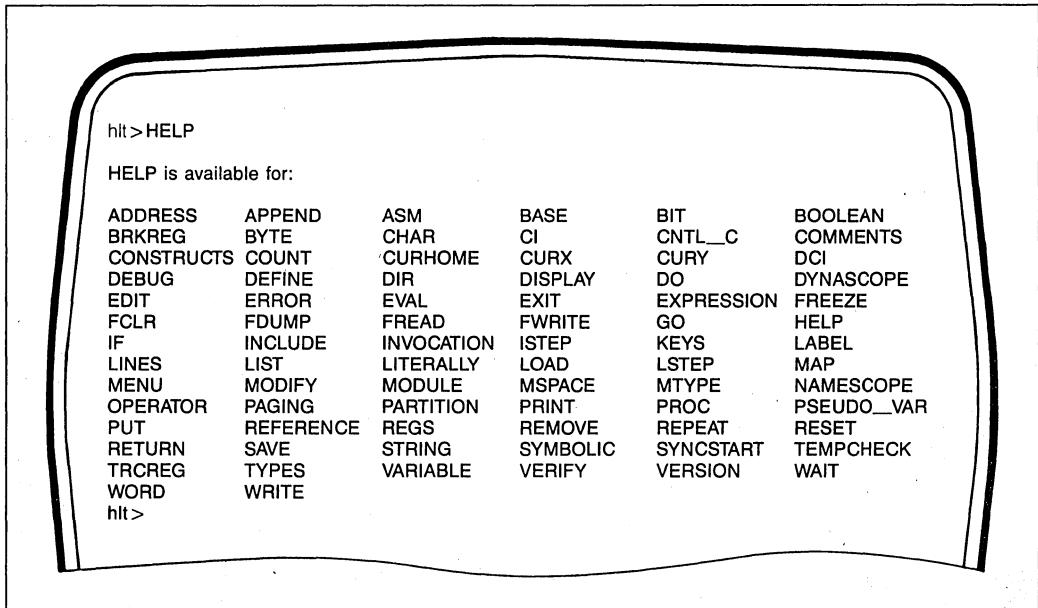


Figure 4. HELP Menu

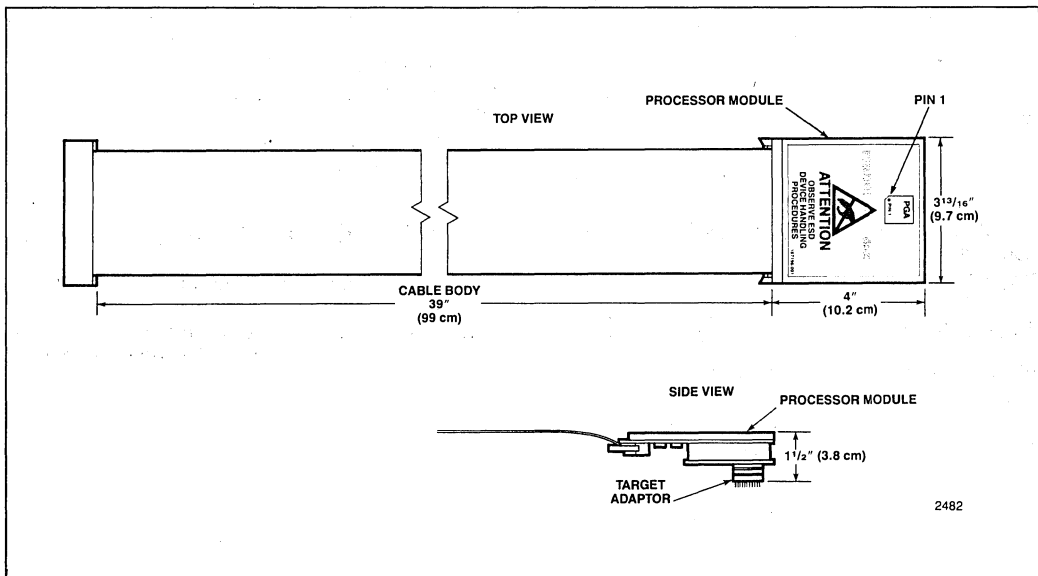


Figure 5. Processor Module Dimensions

## ELECTRICAL CONSIDERATIONS

The emulation processor's user-pin timings and loadings are identical to the 452 component, except as follows:

- Up to 25 pf of additional pin capacitance is contributed by the processor module and target adaptor assemblies.

## HOST REQUIREMENTS

- IBM PC AT or PC XT (or DOS compatible) with 512 KB of available RAM and a hard disk running under the DOS 3.0 (or later) operating system.
- Intellec Series III/IV microcomputer development system running the ISIS or INDX operating system respectively, with at least 512 KB of application memory resident.
- Disk drives — dual floppy or one hard disk and one floppy drive required.

## ICE™-452 EMULATOR SOFTWARE PACKAGE

- ICE-5100/452 emulator software
- ICE-5100/452 confidence tests
- ICE-5100 tutorial software

## EMULATOR PERFORMANCE

### Memory

Mappable full-speed emulation code memory      64 KB      Mappable to user or ICE-5100/452 emulator memory in 4 KB blocks on 4 KB boundaries.

Trace memory      254 × 24 bit frames.

Virtual Symbol Table      A maximum of 61 KB of host memory space is available for the virtual symbol table (VST). The rest of the VST resides on disk and is paged in and out as needed.

## PHYSICAL CHARACTERISTICS

### CONTROLLER POD

Width	8¼"	(21 cm)
Height	1½"	( 3.8 cm)
Depth	13½"	(34.3 cm)
Weight	4 lbs	( 1.85 kg)

### USER CABLE

The user cable is 3 feet (approximately 1 m).

### PROCESSOR MODULE

(With the target adaptor attached.)

Width	3-13/16"	( 9.7 cm)
Height	4"	(10.2 cm)
Depth	1½"	( 3.8 cm)

### POWER SUPPLY

Width	7-5/8"	(18.1 cm)
Height	4"	(10.06 cm)
Depth	11"	(27.97 cm)
Weight	15 lbs	( 6.1 kg)

### SERIAL CABLE

The serial cable is 12 feet (3.6 m).

## ELECTRICAL CHARACTERISTICS

### POWER SUPPLY

100-120 V or 200-240 V (selectable)  
 50-60 Hz  
 2 amps (AC max) <sup>9</sup> 120 V  
 1 amp (AC max) <sup>9</sup> 240 V

## ENVIRONMENTAL CHARACTERISTICS

Operating temperature	+10°C to +40°C (50°F to 104°F)
Operating humidity	Maximum of 85% relative humidity, non-condensing



## ORDERING INFORMATION

### EMULATOR HARDWARE AND SOFTWARE

Order Code	Description
1452KITAD	This kit contains the ICE-5100/452 user probe assembly, power supply and cables, serial cables, target adaptor, CPA, ICE-5100 controller pod, software, and documentation for use with an IBM PC AT or PC XT. The kit also includes the 8051 Software Development Package and the AEDIT text editor for use on DOS systems. (Requires software license.)
1452KITD	This kit is the same as the 1452KITAD kit excluding the 8051 Software Development Package and the AEDIT text editor. (Requires software license.)
1452KITAS	This kit contains the ICE-5100/452 user probe assembly, power supply and cables, serial cables, target adaptor, CPA, ICE-5100 controller pod, software, and documentation for use with Intel hosts (Series III/IV). The kit also includes the 8051 Software Development Package and the AEDIT text editor for use on the Series III/IV. (Requires software license.)
I452KITS	This kit is the same as the I452KITAS kit excluding the 8051 Software Development Package and the AEDIT text editor. (Requires software license.)

### SOFTWARE ONLY

Order Code	Description
SA452D	This kit contains the host, probe, diagnostic, and tutorial software on 5¼" disks for use on an IBM PC AT or PC XT (requires DOS 3.0 or later). (Requires software license.)
SA452S	This kit contains the host, probe, diagnostic and tutorial software on 8" disks (both single-density and double-density) for use on a Series III, and on 5¼" disks for use on a Series IV. (Requires software license.)

## Other Useful Debug and Development Support Products

Order Code	Description
D86ASM51	<b>8051 Software Development Package (DOS version)</b> — Consists of the ASM-51 macro assembler which gives symbolic access to 8051 hardware features; the RL51 linker and relocater program that links modules generated by ASM-51; CONV51 which enables software written for the MCS-48 family to be upgraded to run on the 8051, and the LIB51 Librarian which programmers can use to create and maintain libraries of software object modules. Use with the DOS operating system (version 3.0 or later).
D86PLM51	<b>PL/M-51 Software Package (DOS version)</b> — Consists of the PL/M compiler which provides high-level programming language support; the LIB51 utility that creates and maintains libraries of software object modules, and the RL51 linker and relocater program that links modules generated by ASM-51 and PL/M-51 and locates the linked object modules to absolute memory locations. Use with the DOS operating system (version 3.0 or later).
I86ASM51	<b>8051 Software Development Package (ISIS version)</b> — Same as the D86ASM51 package except this one is for use with the Series III.
I86PLM51	<b>PL/M Software Package</b> — Same as the D86PLM51 package except this one is for use with the Series III and the Series IV.
D86EDINL	AEDIT text editor for use with the DOS operating system.